U.S. Department of Energy
Energy Efficiency and Renewable Energy

Wind Energy Program
Updates and Highlights

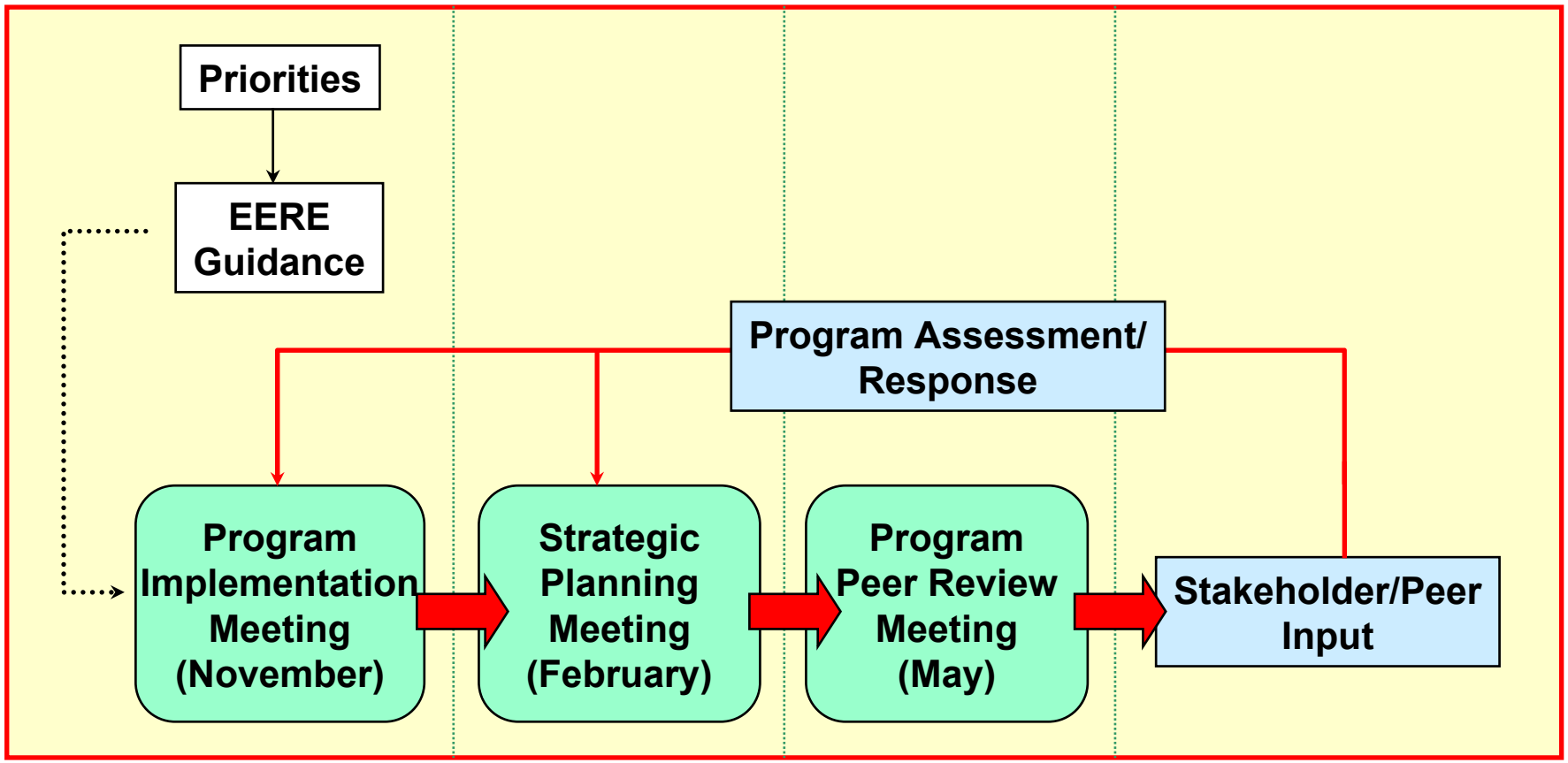
FY 2005 Program Implementation Meeting

November 16, 2004

Stan Calvert
Wind Energy Team Leader
Wind and Hydropower Technologies Program

U.S. Department of Energy
Energy Efficiency and Renewable Energy

Annual Planning Process



U.S. Department of Energy
Energy Efficiency and Renewable Energy

A Future Vision for Wind Energy

2004

Bulk Power Generator
3-5¢ at 15mph

- Land Based
- Bulk Electricity
- Wind Farms

Electricity Market

Future

Land Based Electricity Path

Land Based LWST
Large – Scale
2 - 5 MW

Transmission Barriers

LWST Turbines:
- 3¢/kWh at 13mph
- Electricity Market

2012

Offshore Electricity Path

Offshore Turbines
5 MW & Larger

Cost & Regulatory Barriers

Offshore Turbines:
- 5 cents/kWh
- Shallow/***Deep*** *water*
- Electricity Market
- Higher wind sites

2012 & Beyond

Advanced Applications Path

Land or Sea Based:
- **Hydrogen**
- **Clean Water**

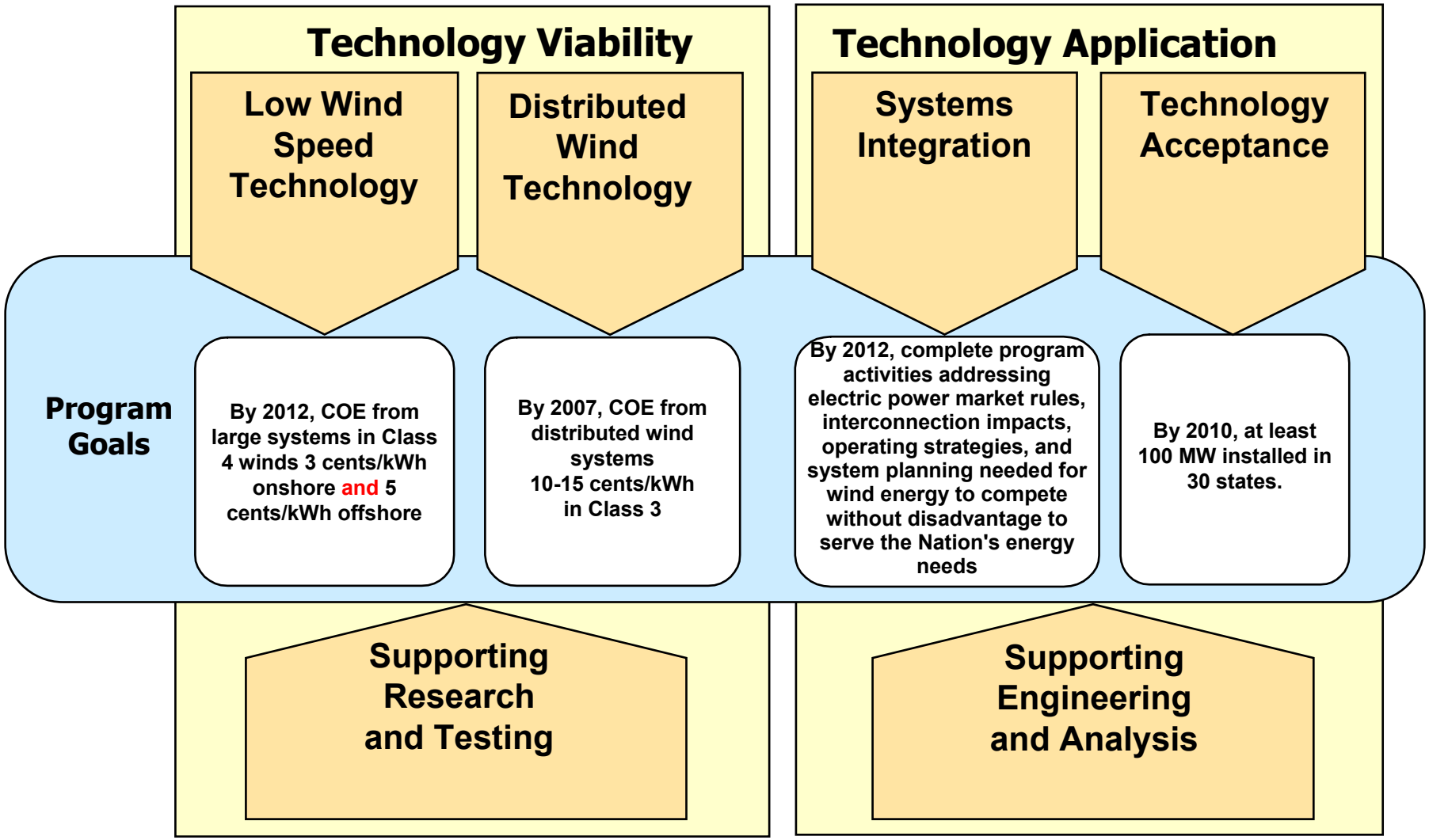
Cost & Infrastructure Barriers

Custom Turbines:
- Electricity
- H2 production
- Desalinate water
- ? Cost
- Multi-Market

2020 & Beyond

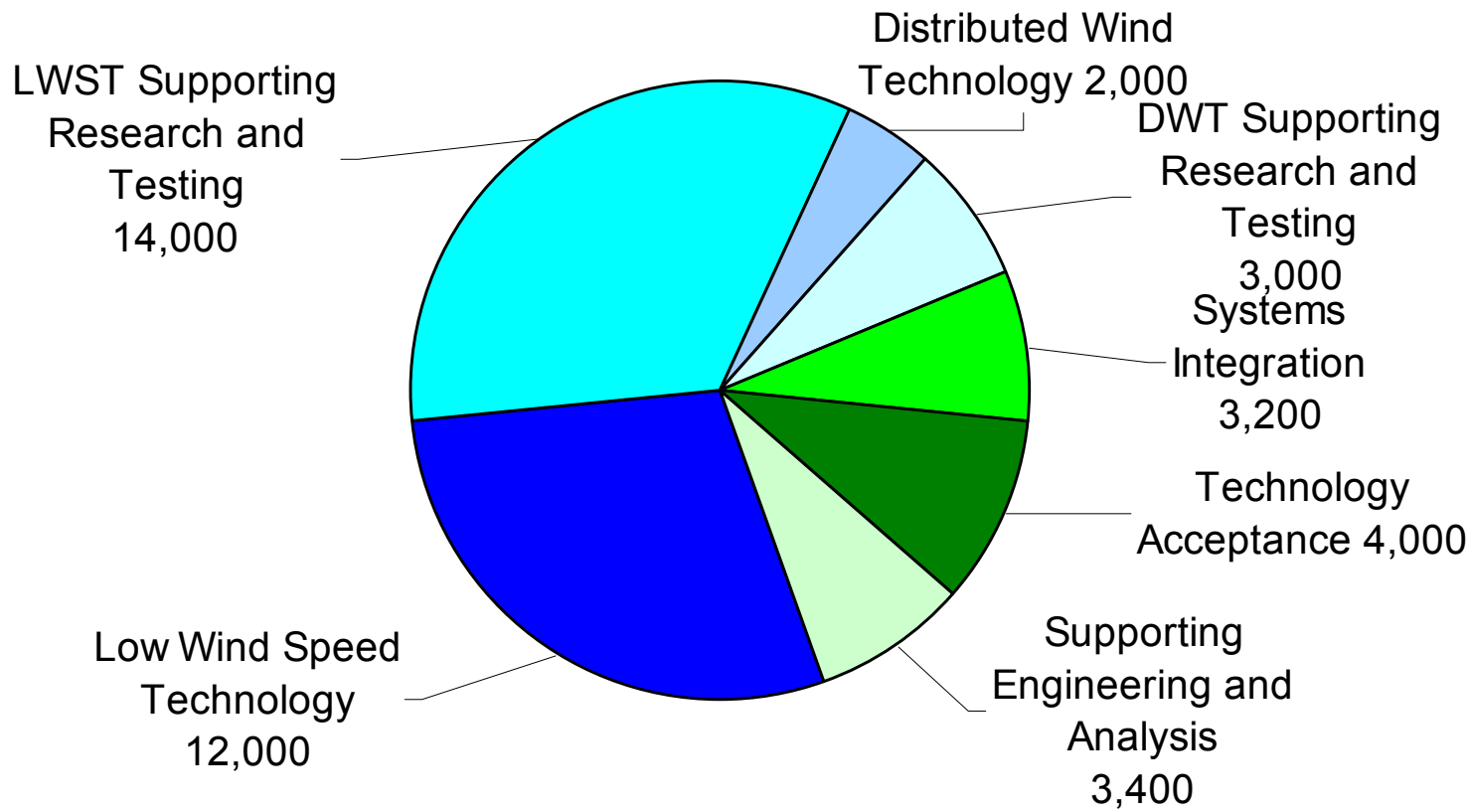
U.S. Department of Energy
Energy Efficiency and Renewable Energy

Program Elements



Program Budget

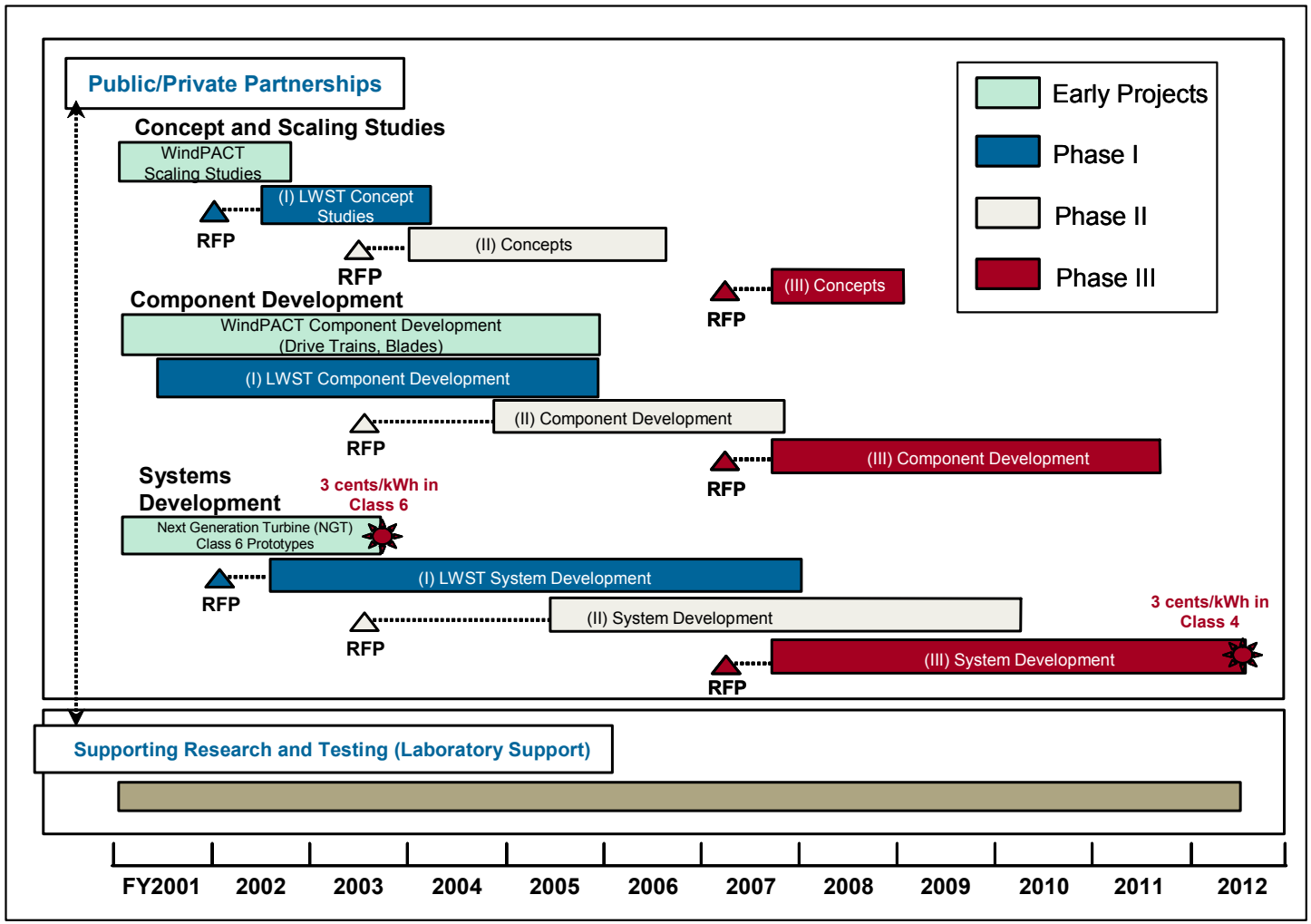
FY05 Budget Request ($Thousands)



U.S. Department of Energy
Energy Efficiency and Renewable Energy

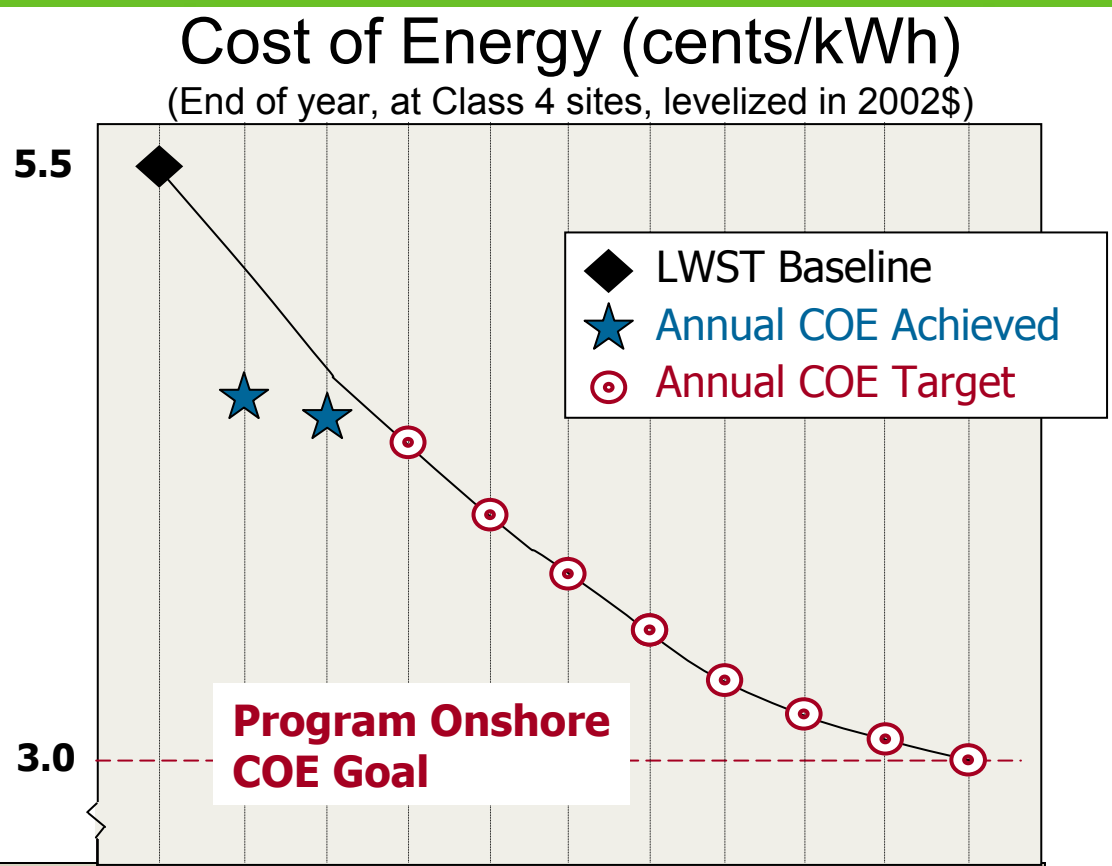
Low Wind Speed Technology (LWST) Project Strategy

(>100 kW)



LWST Progress

- Analytic basis in pathways analysis process
- Upon peer review, provides programmatic progress measure



(in cents/kWh)	2002		2004		2006		2008		2010		2012
LWST Project Targets	5.5	5.0	4.6	4.3	4.0	3.7	3.5	3.3	3.2	3.1	3.0
ATTU	4.8*	4.5	4.4								

ATTU Reference Turbine

U.S. Department of Energy
Energy Efficiency and Renewable Energy

LWST Phase 2 Projects

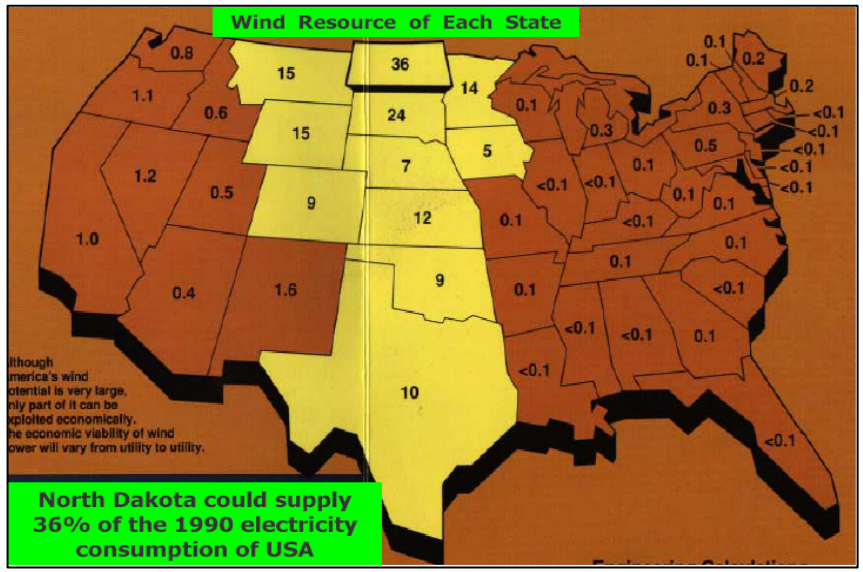
	Title	Partner
	Prototype Systems	
	2 MW Direct Drive Wind Turbine	Northern Power Systems
◎	Multi-Megawatt Offshore System	GE Global Research
	Components	
	Self-Erecting Tower	Valmont Industries, Inc.
	Hybrid Composite Twist-Flap Blade	TPI Composites, Inc.
	CVAR Clipper VAR Control System	Clipper Windpower
	Light Weight Carbon Fiber Windmill Blade Production	HITCO Carbon Composites
	Nacelle Erection System for Tall Towers	Tennessee Valley Infrastructure
◎	Advanced Ultra-Long Blade	GE Global Research
	Convoloid Drive Train Gearing	Genesis, LLP
	Sweep-Twist Adaptive Blade Design and Fabrication	Knight and Carver Yacht Center
	Conceptual Design Studies	
	LIDAR for Turbine Control	QinetiQ
	Medium Voltage Variable Speed Drive Technology	Behnke, Erdman, and Whitaker
◎	Offshore Floating Wind Turbine Concepts	Massachusetts Institute of Technology
◎	Atmospheric Profiling and Modeling Techniques for Offshore Wind Turbines	AWS Scientific
	Multi-Unit Common Shaft, Variable Air-Gap, Axial Flux Permanent Magnet Generator	New Generation Motors
◎	Semi-Submersible Platform and Anchor Foundation Systems	Concept Marine Associates
	Power Electronics From Silicon Carbide	Chinook Power Technologies
	Active Control of Rotor Aerodynamics and Geometry	Global Energy Concepts, LLC
	Integrated Wind Energy/Desalination System	GE Global Research
	Operations and Maintenance Cost Model	Global Energy Concepts, LLC
	Automated Thermal Plate Forming of High Stiffness, Self Erecting Towers	Native American Tech. Co.

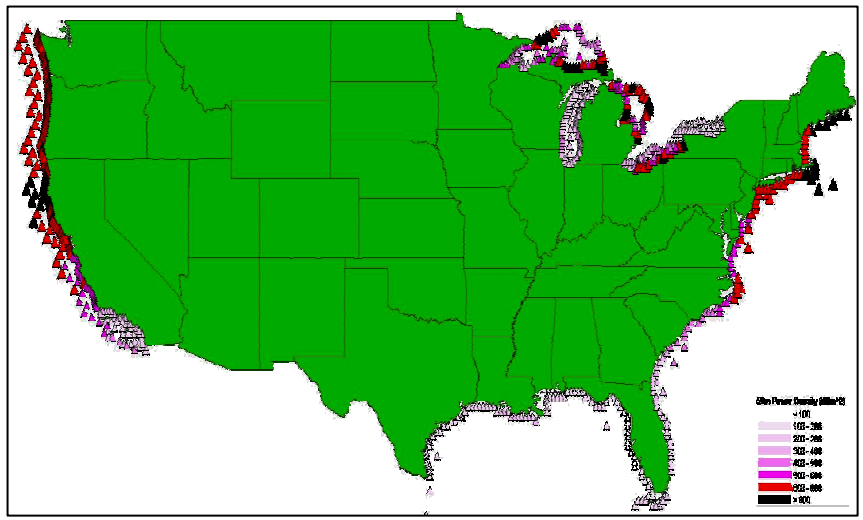
◎ - Offshore wind technology

U.S. Department of Energy
Energy Efficiency and Renewable Energy

Offshore Wind – U.S. Rationale

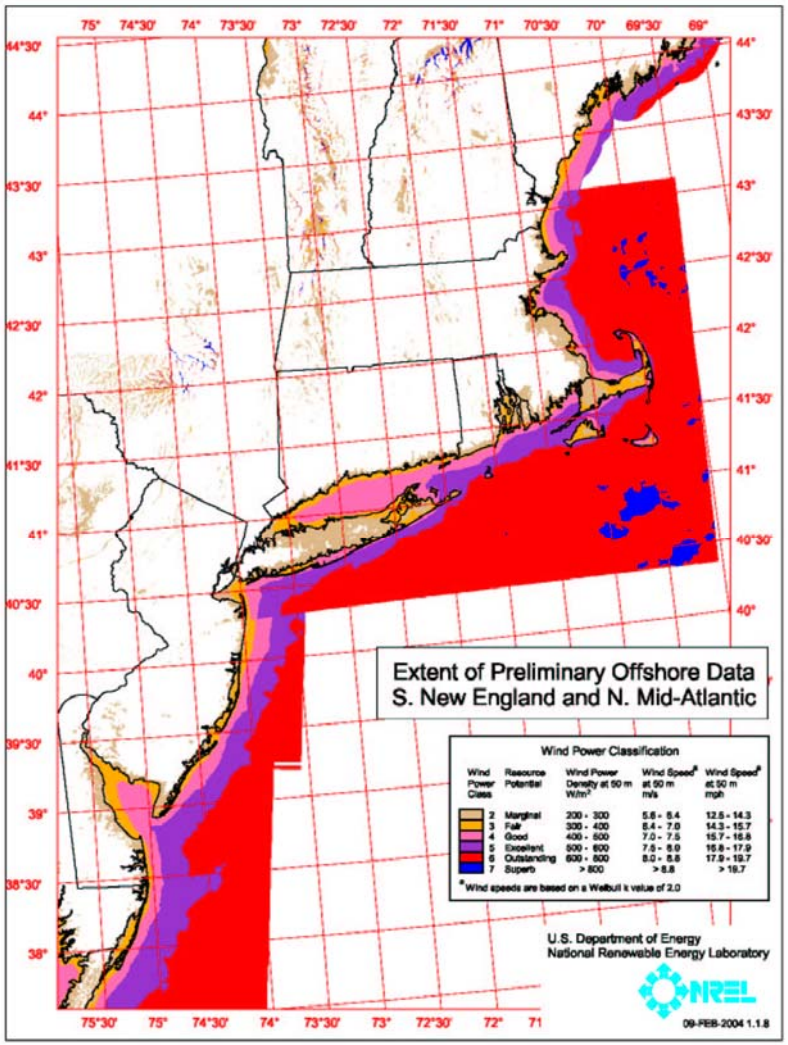
- **Substantial high quality wind resources**
- **Proximity to loads**
  - *Many demand centers near coasts*
- **Increased transmission options**
- **Option to reduce land use and aesthetic concerns**
- **Economies of scale**





U.S. Department of Energy
Energy Efficiency and Renewable Energy

Preliminary Estimate of U.S. Offshore Wind Resource



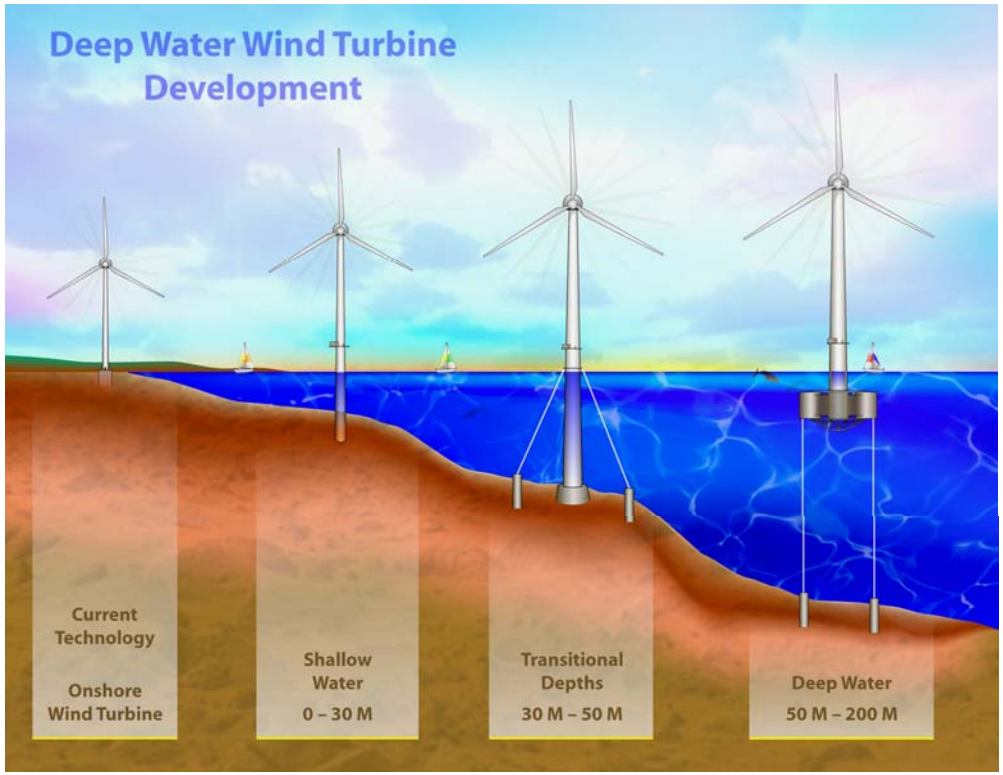
Offshore Resource Estimates in MW 5 - 20 Nautical Miles			
Region	**Shallow Water < 30 m**	**Deep Water > 30 m**	**% Exclusion**
New England	9,900	41,600	67%
Mid Atlantic States	46,500	8,500	67%
California	2,650	57,250	67%
Pacific Northwest	725	34,075	67%
Totals	**59,775**	**141,425**	67%

20 - 50 Nautical Miles			
Region	**Shallow Water < 30 m**	**Deep Water > 30 m**	**% Exclusion**
New England	2,700	166,300	33%
Mid Atlantic States	35,500	170,000	33%
California	0	238,300	33%
Pacific Northwest	0	93,700	33%
Totals	**38,200**	**668,300**	33%

- **Total estimated capacity – 908 GW**

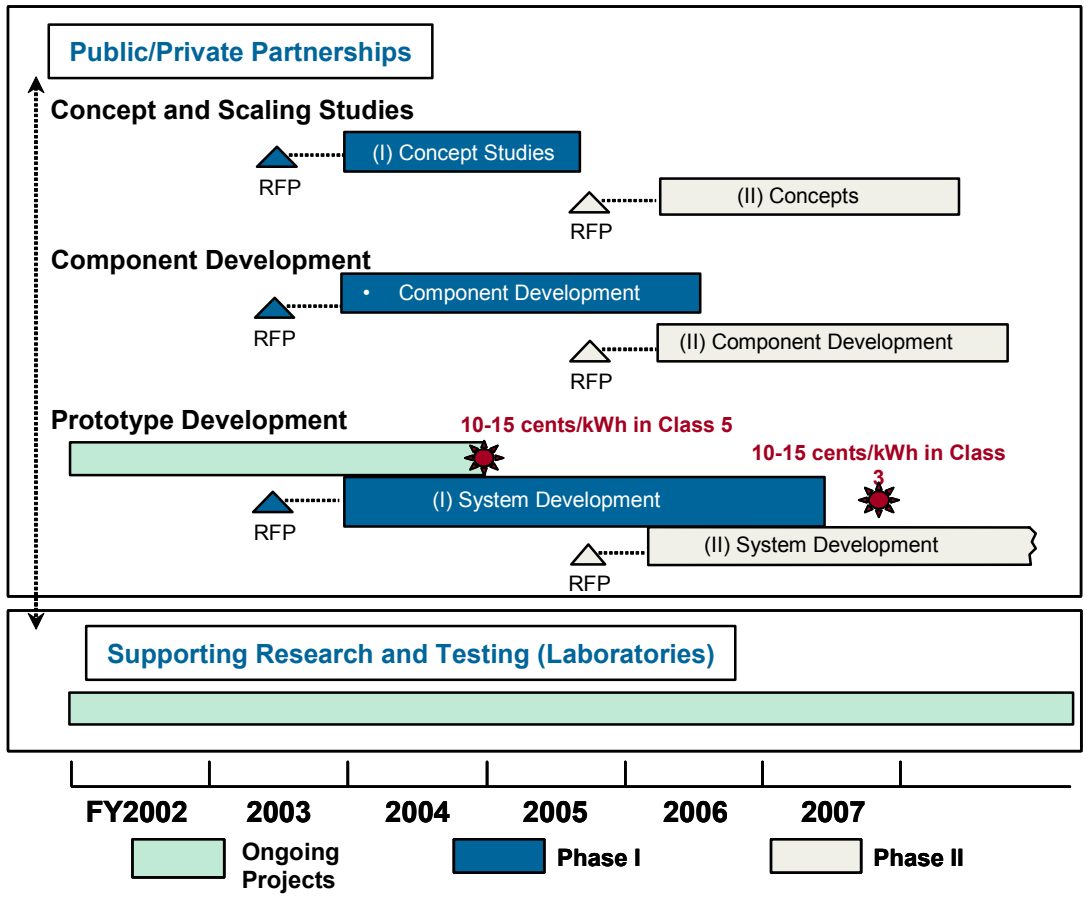
Deep Water Technology

- Second Deep Water Technology Workshop held Oct 26-27
- Offshore Wind Energy Collaborative developing strategic plan
  - DOE, GE, Mass. Technology Collaborative



DWT Project Status

- **Phase I** projects underway
  - All GFO awards, NREL technical support
- **Phase II**
  - GFO RFP for Concepts/Components
  - NREL RFP for System Prototypes
  - 2005 Solicitations, FY2006 funding



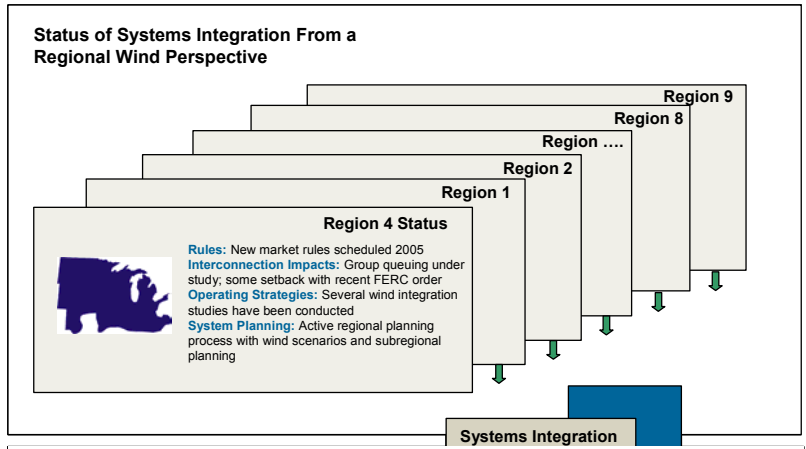
U.S. Department of Energy
Energy Efficiency and Renewable Energy

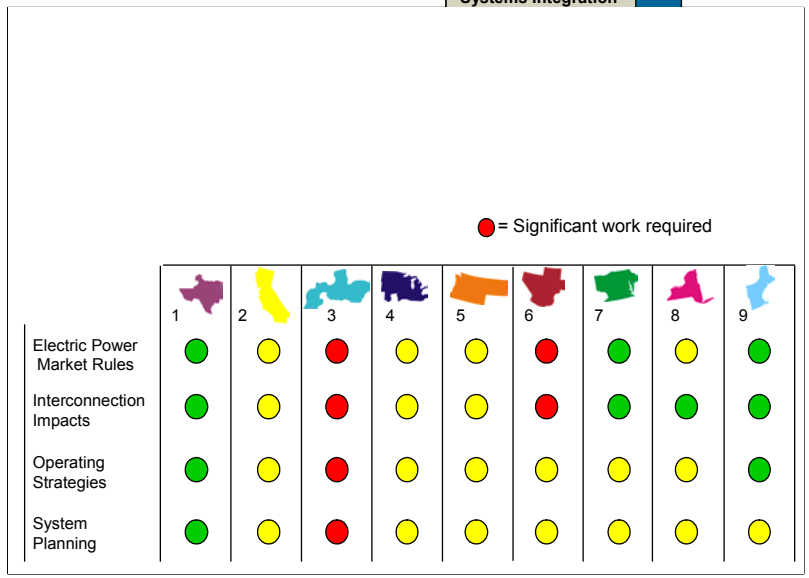
Supporting Research and Testing

- **Enabling Research**
- **Laboratory Support**
- **Testing Facilities** – National Wind Technology Center
  - Testing now at or exceeding current blade test, dyno capacity
  - Expanded Large Wind Turbine Test Facility – Critical Decision 0 Approved, June 2004
  - Budget planning proceeding, not final
  - Current schedule completes in 2008

Systems Integration

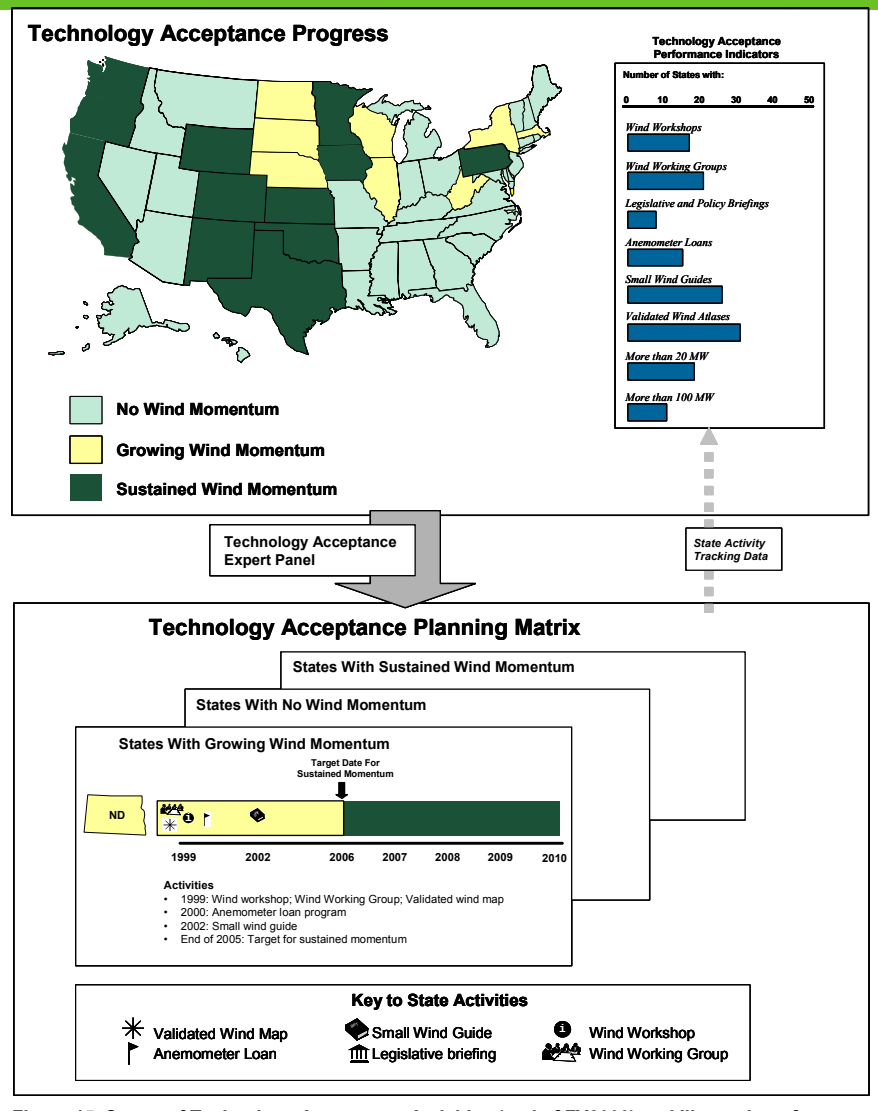
- **Regional Planning/ Assessment framework**
  - Sept. 14 planning meeting
  - Expanded to 9 regions
  - Planning to pilot expert panel regional assessment





Technology Acceptance

- **Shifting to criteria-based framework, vs. State MW thresholds**
  - Better reflects true rationale for engaging States
  - To be vetted in Dec 6-7 Wind Powering America planning meeting



Program Level - 'JOULE' - Milestones

2004 Milestones:

- Completed testing of two advanced LWST drive train prototypes.
- Completed design and manufacture of carbon-glass hybrid blades.
- Completed detailed design for full system low wind speed turbine.

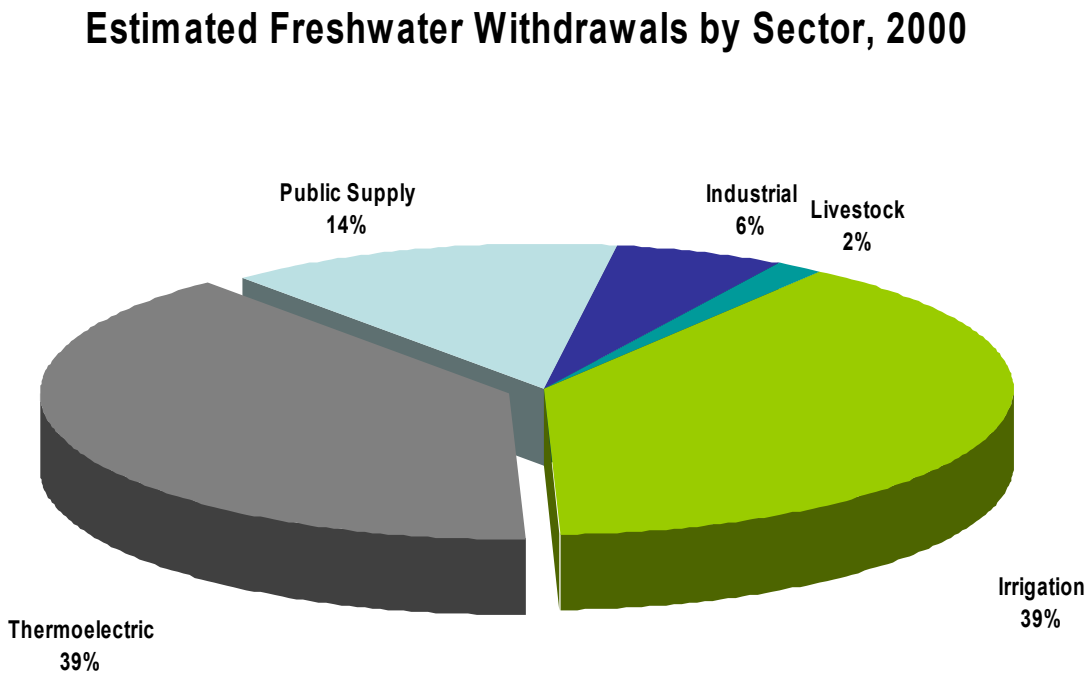
2005 Milestones:

- LWST (Annual COE Target: 4.3 cents per kWh in Class 4 winds)
  - Fabricate and begin testing advanced variable speed power converter.
  - Test first advanced blade.
  - Field test advanced tower and full-scale LWST prototype.
- DWT (Annual COE Target: 12-18 cents per kWh in Class 3 winds)
  - Complete prototype testing of 1.8 KW Small Wind Turbine, finishing IEC tests for acoustics, power, durability, and safety.
- Technology Acceptance
  - 32 states with over 20 MW installed; 16 states with over 100 MW installed

U.S. Department of Energy
Energy Efficiency and Renewable Energy

Water: Opportunity for Wind

- **Water and Energy – Inextricably Linked**
  - Initial NREL studies underway
  - Coordinating with several related federal activities
  - Proposed legislation for commissioning an energy-water program



Source: USGS Circular 1268, March, 2004

Management Notes

- HQ Staffing
  - **Dennis Lin:** Distributed Wind Technology, Supporting Engineering and Analysis
  - **Laura Miner-Nordstrom:** Wind/Water, Technology Acceptance support
  - NREL On-site: **Jason Cotrell**, **Ian Baring-Gould** in January
- Program 'Sharepoint Site'
  - Web repository for program documents, schedules